PATENT SPECIFICATION

DRAWINGS ATTACHED

1096,686

1096,686

Date of filing Complete Specification: Oct. 22, 1965.

Application Date: Oct. 27, 1964. No. 43825/64.

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Index at acceptance: —H1 B(D8B, D8C, D8F, D8J, D8K, D8N, D9E, D9H, D10C, D12)

Int. Cl.: —H 01 m 1/02

COMPLETE SPECIFICATION

Improvements in or relating to Multi-cell Electric Storage Batteries

We, OLDHAM & SON LIMITED, a Company incorporated under the laws of Great Britain, of 36, Hyde Road, Denton, Manchester, England and HAROLD MORTON, a British Subject, of the Company's address, do hereby declare the invention for which we

headspaces with an electrically insulating and non-inflammable granular material, the intercell connections being embedded in the granular material in the headspaces over the adjacent cell boxes.

SPECIFICATION NO. 1,096,688

INVENTOR: HAROLD MORTON

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of OLDHAM & SON LIMITED, a British Company, of 36 Hyde Road, Denton, Manchester, Lancashire.

THE PATENT OFFICE

D 100725/13

sparking should a metal object be dropped on to the top of the battery. Also severe mechanical impact might cause sufficient distortion of the battery to cause the intercell connections to short circuit against each other.

It is a main object of the present invention to provide a multi-cell electric storage battery which can be used safely in an explosive atmosphere, for example in mines.

A multi-cell electric storage battery according to the present invention comprises a plurality of cells each sealed into its cell box with terminals extending through the lid of the box, each cell box being housed in an individual closed cell container which defines a headspace over the cell box, and at least one intercell connection joining terminals of adjacent cells, which connection extends through the headspaces over the adjacent cells.

The provision of a headspace around the intercell connectors provides a degree of protection against accidental short circuiting. This protection may be enhanced according to a further feature of the invention by filling the

an accident is eliminated. The construction of a battery according to the invention also eliminates the risk of explosion if the battery should be severely distorted causing short circuiting between the terminals of its cells and the granular material acts to cushion the battery against damage caused by a severe blow.

In the preferred embodiment of the invention, the cells in their cell containers are located in a battery outer casing.

Preferably, in accordance with the invention, each cell container comprises an individual cover which closes the top of the container.

The electrically insulating and non-inflammable granular material filling the headspace is preferably silica beads or expanded polystyrene and has a granular size of 1/8" or less.

To ensure maximum protection against sparking in the event of an accident, the intercell connection passes through a hollow gland filled with said granular material, which gland fits into juxtaposed walls of the con-

[*Price 4s. 6d.*]

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COMPLETE SPECIFICATION

Improvements in or relating to Multi-cell Electric Storage Batteries

We, OLDHAM & SON LIMITED, a Company incorporated under the laws of Great Britain, of 36, Hyde Road, Denton, Manchester, England and HAROLD MORTON, a British Subject, of the Company's address, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to multi-cell electric storage batteries and, more particularly, to batteries for use in traction vehicles in mines.

In some traction batteries in use at present in mines, for example batteries for mining locomotives, the intercell connections are situated at the tops of the cells and are very vulnerable to short circuiting with consequent sparking should a metal object be dropped on to the top of the battery. Also severe mechanical impact might cause sufficient distortion of the battery to cause the intercell connections to short circuit against each other.

It is a main object of the present invention to provide a multi-cell electric storage battery which can be used safely in an explosive atmosphere, for example in mines.

A multi-cell electric storage battery according to the present invention comprises a plurality of cells each sealed into its cell box with terminals extending through the lid of the box, each cell box being housed in an individual closed cell container which defines a headspace over the cell box, and at least one intercell connection joining terminals of adjacent cells, which connection extends through the headspaces over the adjacent cells.

The provision of a headspace around the intercell connectors provides a degree of protection against accidental short circuiting. This protection may be enhanced according to a further feature of the invention by filling the headspaces with an electrically insulating and non-inflammable granular material, the intercell connections being embedded in the granular material in the headspaces over the adjacent cell boxes.

A battery constructed in accordance with the present invention is particularly suited for use where an explosive atmosphere is likely to be encountered, e.g. in mines, because a metal object falling on to the top of the battery cannot usually make contact with the intercell connections. If, however, the metal object falls with sufficient force to pierce a cell container and make contact with the intercell connections, any sparking is immediately quenched by the surrounding granular material, and thus an explosion which would normally result from sparking caused by such an accident is eliminated. The construction of a battery according to the invention also eliminates the risk of explosion if the battery should be severely distorted causing short circuiting between the terminals of its cells and the granular material acts to cushion the battery against damage caused by a severe blow.

In the preferred embodiment of the invention, the cells in their cell containers are located in a battery outer casing.

Preferably, in accordance with the invention, each cell container comprises an individual cover which closes the top of the container.

The electrically insulating and non-inflammable granular material filling the headspace is preferably silica beads or expanded polystyrene and has a granular size of 1/8" or less.

To ensure maximum protection against sparking in the event of an accident, the intercell connection passes through a hollow gland filled with said granular material, which gland fits into juxtaposed walls of the con-

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tainers of adjacent cells and protects the intercell connection where it passes from the headspace of one cell into the headspace of the adjacent cell.

The intercell connection is preferably of inverted U-shape and the base of the U passes through said gland.

Each terminal is preferably a terminal post the upper end of which is formed, according to the invention, as a vertical socket into which one end of an intercell connection is inserted, the socket is then being crimped on to the end of the connection. This form of connection eliminates the necessity for burning a new connection when one cell of a battery has to be replaced, and thus enables replacement of cells to be made safely in an explosive atmosphere and thus, in the case of traction batteries for use in mines, avoids the expense and work involved in taking a battery to the surface for cell replacement.

In the preferred embodiment of the invention, the walls of each cell container are made of an epoxy resin glass wool or steel coated with an insulating material.

The cell boxes are preferably made of polypropylene.

The covers of the cell containers are preferably made of polyester glass wool.

In a preferred embodiment of the present invention, each cell box includes an electrolyte filler pipe communicating with the cell and extending upwardly through the headspace from the lid of the cell box, and each cell container includes an aperture in register with the upper end of the filler pipe.

Preferably, the filler pipe is internally threaded at its upper end to receive a filler vent plug having an externally threaded stem with a passage extending longitudinally through the stem, and a head formed with a radially and downwardly extending skirt and an aperture under said skirt, said aperture communicating with the passage through the stem of the plug.

The present invention also comprehends a battery comprising an intercell connection having two parts which are jointed by a metal sleeve embracing and crimped on to the ends of the two parts, the metal sleeve being accommodated by the hollow gland. Such a joint facilitates servicing the battery, particularly in an explosive atmosphere, e.g. in mines as hereinafter described.

In the preferred embodiment of the invention the connection between adjacent cells is made by interconnecting by means of two intercell connections, two terminal posts of one polarity of each cell to two terminal posts of the other polarity of an adjacent cell.

The present invention also comprehends a method of assembling a multi-cell electric storage battery as described above, comprising sealing a plurality of cells into individual cell boxes with the terminals of each cell extending through the lid of its box, housing each cell box in an individual cell container which defines a headspace over the cell box, locating the cell boxes, housed in their cell containers, in a battery outer casing, joining together appropriate terminals of the cells with intercell connections extending through the walls of the cell containers, and filling the headspaces over the cell boxes with electrically insulating and non-inflammable granular material so that the intercell connections are embedded in the granular material, and fitting covers over the individual cell containers.

In order that the invention may be more clearly understood, a preferred embodiment thereof will now be described, by way of example, with reference to the drawings accompanying the Provisional Specification in which:—

Figure 1 shows a longitudinal section through two interconnected cells of an electric storage battery in accordance with the invention,

Figure 2 shows a transverse section of the cell in its cell container along the line II—II of Figure 1,

Figure 3 shows a section through part of a cell container constructed according to the invention, and

Figure 4 shows a section through a jointed intercell connection in accordance with the invention.

The electric storage battery according to the invention shown in Figures 1 and 2 comprises two cells 1 and 2 each sealed into a cell box. The cell boxes each comprise an electrolyte container 3 or 4. The container 3 has a lid 5 sealed around the periphery of the container 3 by a pitch seal 6. Similarly a lid 7 is sealed to the top of the container 4 by a pitch seal 8.

Two positive terminals posts 9 and 9*a*, and two negative terminal posts 10 and 10*a* extend through the lid 5 of the cell 1. Two positive terminal posts 11 and 11*a* and two negative terminal posts 12 and 12*a* extend through the lid 7 of the cell 2. The terminal posts 9*a* and 12*a* are situated directly behind the terminal posts 9 and 12 in Figure 1. The terminal posts are preferably made of lead. Each terminal post passes through an aperture 13 and is sealed into the aperture by annular sealing rings 14 which make a liquid-tight seal between the terminal post and the wall of the aperture 13.

The top of each terminal post is formed with a thread and a nut 15 is screwed on to each post to hold it in position.

The lower ends of the positive terminal posts 9 and 9*a* of cell 1 are connected to a connector bar 16 which extends transversely of the cell and the bar 16 connects together in known manner the positive ones, which are alternate ones, of the cell plates 17. The nega-

tive terminal posts 10 and 10a are connected to a connector bar 18 which connects together the negative ones of the plates 17. The plates 17 are supported at their lower edges by supports 19 which extend transversely of the cells and are set into the bottoms of the electrolyte containers 3 and 4. Similarly the terminal posts 11, 11a, 12 and 12a of cell 2 are connected to connector bars 20, 21.

The two cells 1 and 2 are housed in identical cell containers 22 and 23 respectively. The cell container 22 comprises four walls 24, 25, 26 and 27 (Figures 1 and 2), which form a rectangular sleeve around the cell 1. The cell container 22 also comprises a cover 28. The cell container 23 is of the same construction as the cell container 22 and has a cover 29. As described below, the cell containers 22 and 23 are kept in spaced relationship by ribs 30 and 31 on the juxtaposed walls of the respective containers, in a battery outer casing.

The inner faces of the walls 24, 25, 26 and 27 of the cell container 22 are formed with shoulders 32 upon which rest flanges 33 formed round the upper edges of the electrolyte container 3, whereby the cell 1 is supported in its cell container 22. The cell 2 is similarly supported in its cell container 23.

The cell containers 22 and 23 are taller than the electrolyte containers 3 and 4 and thus define headspaces 34 and 35 over the cell boxes between the lids 5 and 6 of the cells 1 and 2 and the respective covers 28 and 29 of the cell containers 22 and 23. The headspaces 34 and 35 are, in the embodiment described, filled with electrically insulating and non-inflammable granular material 36 having a granule size not greater than 1/8" and preferably smaller, for example 0.1", which may be constituted by, for example, silica beads, expanded polystyrene or a particulate material, e.g. sand.

The negative terminal posts 10 and 10a of cell 1 are joined to the two positive terminal posts 11 and 11a of cell 2 by two intercell connections 37 and 38. Each of the intercell connections 37 and 38 consists of a multistrand copper cable 39 with an insulating covering 40 (see Figure 1). The intercell connections 37 and 38 are bent to an inverted U-shape.

The upper ends of the terminal posts 10 and 11 are formed as vertical cylindrical sockets 41 and 42 respectively (see Figure 1). The sockets 41 and 42 are lined with copper sleeves 43 and 44. The bared ends of the intercell connection 37 are inserted into the lined sockets 41 and 42, and the sockets 41 and 42 are crimped on to the ends of the intercell connection 37 to form a low resistance connection. The upper ends of the terminal posts 10a and 11a are similarly formed as sockets which are crimped over the ends of intercell connection 38.

Thus the intercell connections 37 and 38 are completely embedded in the granular material 36 in the chambers 34 and 35.

The terminal posts 9, 9a, 12 and 12a are similarly formed with sockets for crimping on to other intercell connections. The positive or negative terminal posts, as appropriate, of the end cells of the battery are plain terminal posts on to which output cables of the battery are bolted.

It is preferred to use two terminal posts, with associated intercell connections, to each connector bar, making a total of four terminal posts per cell, as described. By using this construction, in the event of one intercell connection breaking the other will carry the current and the danger of arcing occurring is eliminated. Furthermore, the use of two terminal posts per connector bar keeps the internal resistance of the battery at a minimum, but for some applications only one may be employed on each connector bar.

The wall 27 of cell container 22 and the juxtaposed wall 45 of the cell container 23 are cut away to accommodate the two intercell connections 37 and 38 as indicated in broken lines at 46 and 47 in Figure 2, above the level of the cell box lids 5 and 6. Two identical hollow glands, indicated generally at 48 and 49 in Figure 2, fit into the walls 27 and 45 where they are cut away at 46 and 47. For convenience, only the hollow gland 48 will be described. The hollow gland 48 consists of a lower semi-circular part 50 and an upper rectangular part 51. Flanges 52 round the periphery of the gland 48 fit around the cut out portions 46 and 47 of the juxtaposed walls 27 and 45 of the cell containers 22 and 23. The gland 48 is filled with the same electrically insulating and non-inflammable granular material as fills the headspaces 34 and 35, the gland being filled with said material through a rectangular passage 53 in the upper part 51. The two parts 50 and 51 of the gland 48 are formed with notches 54 and 55 which accommodate the base of the U-shape of the intercell connection 37, thus providing protection for the intercell connection 37 where it passes from one of the headspaces 34, 35 to the other headspace. The identical hollow gland 49 similarly protects the intercell connection 38.

Filler pipes 56 and 57 for the cells extend upwardly from the respective lids 5 and 6 of the cells 1 and 2, through the headspaces 34 and 35. The covers 28 and 29 have apertures in register with the upper ends of the filler pipes 56 and 57, aperture 58 in the cover 28 being shown in Figure 2 in register with the upper end 59 of the filler pipe 56.

Referring to Figure 2, the upper end 59 of the filler pipe 56 is internally threaded to receive a filler vent plug, indicated generally at 60. The plug 60 has an externally threaded stem 61 with a passage 62 extending

longitudinally through the stem 61. The plug 60 has a head consisting of horizontal annular part 63 extending outwardly round the top of the stem 61, a vertical wall 64 round the perpihery of the annular part 63, a skirt 65 which extends radially and downwardly towards the cover 28, and a plate 66 completing the top of the plug. A downwardly directed aperture 67 is located in the horizontal annular part 63 of the plug, under the skirt 65, and serves as a breathing hole for the cell 1.

A sealing ring 68 makes a liquid-tight seal between the filler vent plug 60 and the cover 28 and prevents the skirt 65 making contact with the lid, which would impair the breathing of the cell.

The positioning of the aperture 67 under the skirt 65 which extends close to the cover 28, permits the battery to be hosed down without water entering the cell and thus the cell container 22 can be kept clean and free from acid, thereby eliminating the possibility of electrical tracking over the outside of the container.

The cell containers 22 and 23 are made from a hard, puncture resistant material such as polyester glass wool, epoxy resin glass wool, or steel coated with an insulating material such as polythene. Figure 3 shows part of a cell container in which the wall 69 is made from steel sheet 70 coated on both sides with polythene 71. The cover 72 is made from polyester glass wool, and has a flange 73 which fits round the outside of the wall of the container.

The cell boxes are made from a crack-resistant material such as, for example, polypropylene.

The assembly of a battery in accordance with the invention will now be described, making reference to Figures 1 and 2 of the drawing for clarity, though it will be understood that in practice, a battery, e.g. a traction battery, would include more than two cells. The present method of assembling a battery is applicable to a battery having any number of cells.

In assembling a battery in accordance with the invention, the cells 1 and 2 are sealed into individual cell boxes. The cell boxes are then lowered into individual cell containers 22 and 23 which form sleeves around the cells.

The cell boxes, housed in their cell containers 22, 23 are located in a steel battery outer casing of known type, which casing, if the battery is for traction purposes, will be the battery compartment of the locomotive or other electric vehicle in which the battery is to be used. The floor of the battery outer casing is shown at 74. The cells are kept in a spaced relationship to each other by ribs 30, 31 on the cell containers or by spacers.

To assemble each of the glands, e.g. the gland 48, the semi-circular lower part 50 of the gland 48 is fitted into the cut out portions 46 and 47 of the juxtaposed walls 27 and 45 of the cell containers 22 and 23, the ends of the intercell connection 37 are inserted into the copper linings 43, 44 of the sockets 41, 42 of the terminal posts 10 and 11 and the sockets are crimped on to the respective ends of the connections to form a low resistance connection at each end of the intercell connection 37. The intercell connection 38 is similarly connected between the terminal posts 10*a* and 11*a*, and further intercell connections are connected to the terminal posts 9, 9*a*, 12 and 12*a* and to appropriate terminal posts of cells adjacent the cells 1 and 2. However, if, for example, the cell 1 is an end cell of the battery, output cables would be connected to the terminal posts 9 and 9*a*. The lower part 50 of the gland 48 is filled with granular material, the upper part 51 of the gland 48 is fitted above the lower part 50 and is then filled with the granular material through the rectangular passage 53 in the upper part 51. The head spaces 34 and 35 are filled with the granular material, thereby embedding the intercell connections 37 and 38 in the granular material. The covers 28 and 29 are fitted to the cell containers 22 and 23, the cells 1 and 2 are filled to the correct level with electrolyte, and the filler vent plugs are screwed down on to sealing rings 68. The battery is then ready for operation.

Figure 4 shows a joint in an intercell connection. A copper sleeve 75 embraces the free ends 76 and 77 which are to be joined, and the ends of sleeve 75 are crimped on to the ends 76 and 77 to form a low resistance joint in the intercell connection. The sleeve 75 is located in the notches 54 and 55 of the hollow gland 48.

The use of such a joint facilitates removal and replacement of a defective cell. For example, if the cell 1 is defective, the cover 28 of the defective cell 1 is removed, the granular material 36 in the headspace over the cell and the two parts of the glands connecting the cell to its neighbours are also removed. The intercell connections e.g. connections 37 and 38 are sawn through at the mid point of the base of the 'U', i.e., between the juxtaposed walls 27 and 45 of the containers 22 and 23 of the cells 1 and 2, and the defective cell 1 is lifted out. The replacement cell is assembled with halved intercell connections, thus when lowered into position in the battery the halved connections of the replacement cell match up with the halved connections of its neighbouring cells. Connection of the replacement cell to the adjacent cell is achieved by baring the ends 76, 77 of the halved connections, inserting them in the copper sleeve 75, and crimping both ends of the copper sleeve 75 on to the ends 76, 77 of the halved connections. The glands, the granular material

36, the cover and the vent plug are then placed in position.

By jointing the intercell connection in this way, replacement of defective cells can be effected even in an explosive atmosphere, because no burning of the new intercell connection is necessary.

In the preferred embodiment which is illustrated in the drawings, by way of example, the headspaces over the cell boxes are filled with a granular, electrically insulating material. This granular material may be omitted both from the headspaces and from the glands 48 and 49, and the presence of the headspaces in which the intercell connectors are located alone provides an acceptable degree of protection against the risks of accidental short circuiting.

It will be appreciated that a multi-cell electric storage battery constructed in accordance with the present invention is safe for use in explosive atmospheres, such as occur in mines, because its construction eliminates the possibility of explosion resulting from any accidental impact on the battery.

WHAT WE CLAIM IS:—

1. A multi-cell electric storage battery comprising a plurality of cells each sealed into its cell box with terminals extending through the lid of the box, each cell box being housed in an individual closed cell container which defines a headspace over the cell box, and at least one intercell connection joining terminals of adjacent cells, which connection extends through the headspaces over the adjacent cells.

2. A multi-cell electric storage battery comprising a plurality of cells each sealed into its cell box with terminals extending through the lid of the box, each cell box being housed in an individual closed cell container which defines a headspace over the cell box, which headspace is filled with an electrically insulating and non-inflammable granular material, and at least one intercell connection joining terminals of adjacent cells, which connection is embedded in the granular material in the headspaces over the adjacent cell boxes.

3. A battery according to Claim 2, wherein the cells in their cell containers are located in a battery outer casing.

4. A battery according to Claim 2 or Claim 3, wherein each cell container comprises an individual cover which closes the top of the container.

5. A battery according to any one of Claims 2 to 4, wherein the electrically insulating and non-inflammable granular material is silica beads or expanded polystyrene, and has a granular size of 1/8 inch or less.

6. A battery according to any one of Claims 2 to 5, wherein the intercell connection passes through a hollow gland filled with said granular material, which gland fits into juxtaposed walls of the containers of adjacent cells and protects the intercell connection where it passes from the headspace of one cell into the headspace of the adjacent cell.

7. A battery according to Claim 6, wherein the intercell connection is of inverted U-shape and the base of the U passes through said gland.

8. A battery according to any one of the preceding Claims, wherein each terminal is a terminal post the upper end of which is formed as a vertical socket into which one end of an intercell connection is inserted, the socket then being crimped on to the end of the connection.

9. A battery according to any one of the preceding Claims, wherein the walls of each cell container are made of an epoxy resin glass wool or steel coated with an insulating material.

10. A battery according to any one of the preceding Claims, wherein the cell boxes are made of polypropylene.

11. A battery according to any one of Claims 3 to 8, wherein the cell container covers are made of polyester glass wool.

12. A battery according to any one of the preceding Claims, wherein each cell box includes an electrolyte filler pipe communicating with the cell and extending upwardly through the headspace from the lid of the cell box, and each cell container includes an aperture in register with the upper end of the filler pipe.

13. A battery according to Claim 12, wherein each filler pipe is internally threaded at its upper end, to receive a filler vent plug having an externally threaded stem with a passage extending longitudinally through the stem, and a head formed with a radially and downwardly extending skirt and an aperture under said skirt, said aperture communicating with the passage through the stem of the plug.

14. A battery according to any one of Claims 6 to 13, comprising an intercell connection having two parts which are jointed by a metal sleeve embracing and crimped on to the ends of the two parts, the metal sleeve being accommodated by the hollow gland.

15. A battery according to any one of the preceding Claims, wherein the connection between adjacent cells is made by interconnecting by means of two intercell connections, two terminal posts of one polarity of each cell to two terminal posts of the other polarity of an adjacent cell.

16. A method of assembling a multi-cell electric storage battery according to Claim 1, comprising sealing a plurality of cells into individual cell boxes with the terminals of each cell extending through the lid of its box, housing each cell box in an individual

cell container which defines a headspace over the cell box, locating the cell boxes, housed in their cell containers, in a battery outer casing, joining together appropriate terminals of the cells with intercell connections extending through the walls of the cell containers and located in said headspaces, and fitting covers over the individual cell containers.

17. A method of assembling a multi-cell electric storage battery according to Claim 2, comprising sealing a plurality of cells into individual cell boxes with the terminals of each cell extending through the lid of its box, housing each cell box in an individual cell container which defines a headspace over the cell box, locating the cell boxes, housed in their cell containers, in a battery outer casing, joining together appropriate terminals of the cells with intercell connections extending through the walls of the cells containers, filling the headspaces over the cell boxes with electrically insulating and non-inflammable granular material so that the intercell connections are embedded in the granular material, and fitting covers over the individual cell containers.

18. A multi-cell electric storage battery constructed substantially as herein described with reference to the drawings accompanying the Provisional Specification.

19. A method of assembling a multi-cell electric storage battery substantially as herein described with reference to the drawings acompanying the Provisional Specification.

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Agents for the Applicants.

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Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

Fig.1.

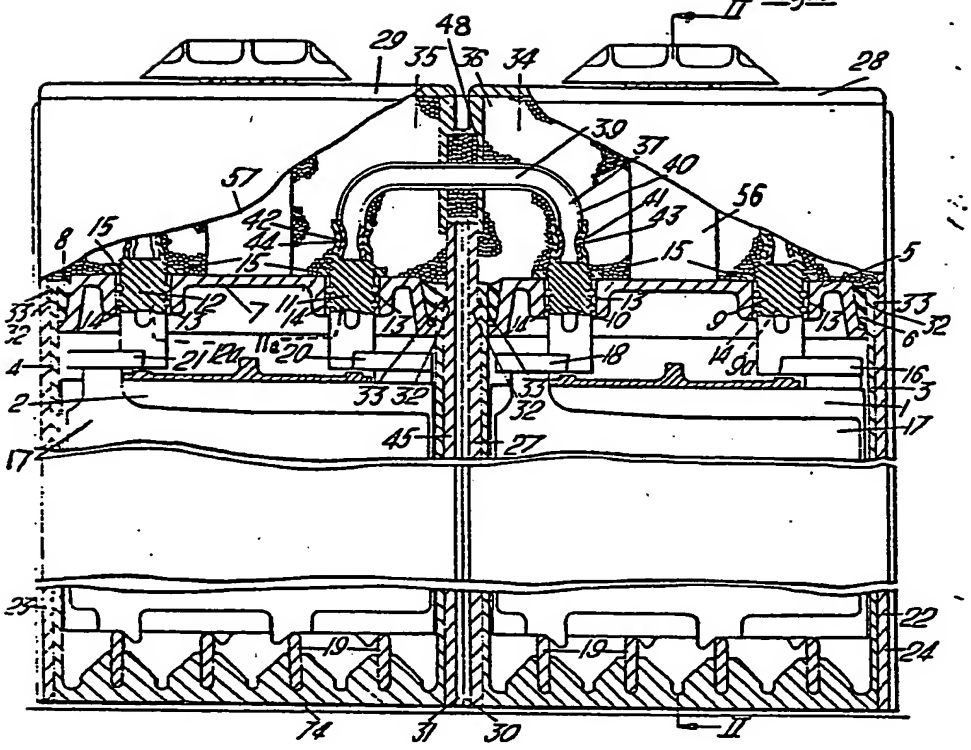
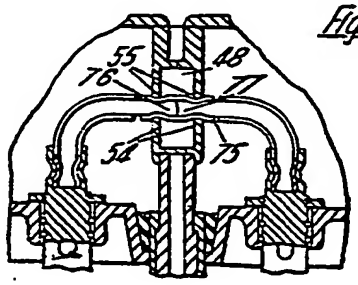


Fig.4.



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2 SHEETS

PROVISIONAL SPECIFICATION

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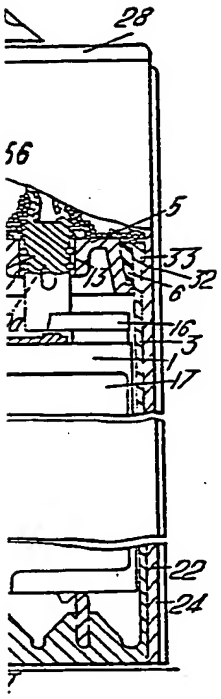
Sheets 1 & 2

Fig.1.



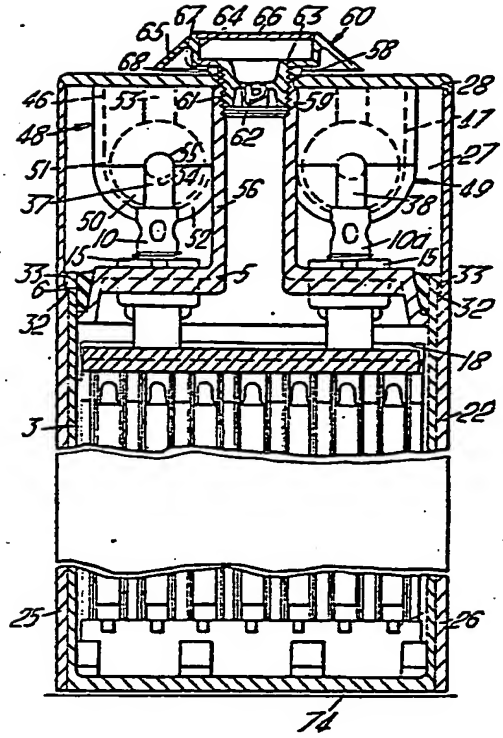
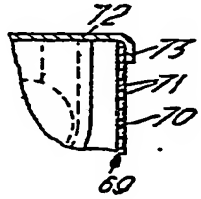


Fig.2

Fig.3.



1096686 PROVISIONAL SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

Fig.1.

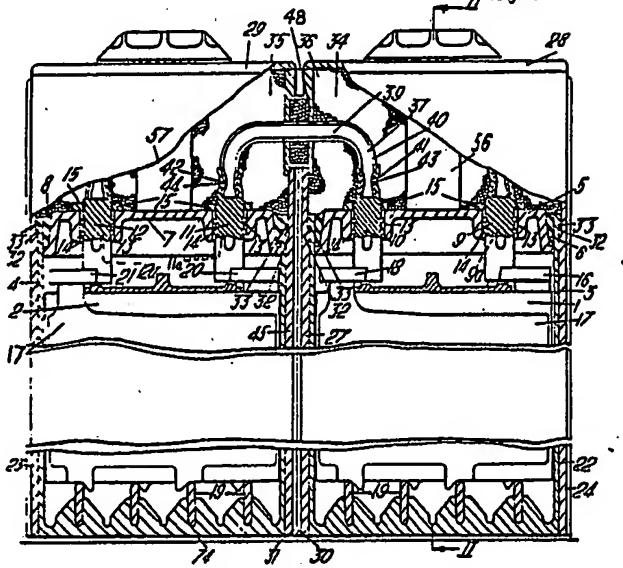


Fig.2.

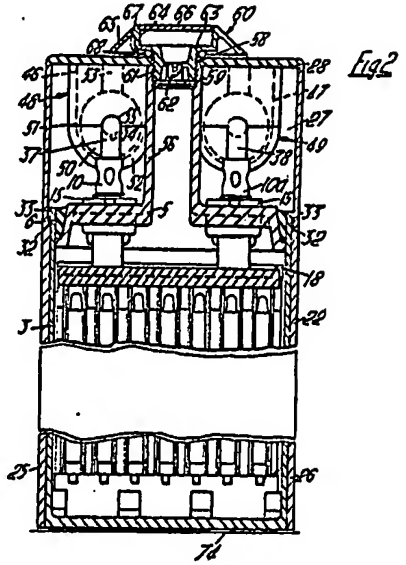


Fig.4.

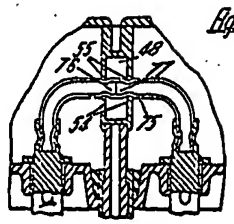


Fig.3.